

09:00-09:20: Introduction

09:20-10:15: Threats

André Moan: Bycatches of marine mammals in Norwegian fisheries – monitoring, quantification and mitigation

Bycatch and bycatch mitigation: In Norway, every year, many harbour porpoises, and harbour and grey seals drown because they get entangled in static gillnets set by fishing vessels that target commercial fish species. Previous studies indicate that the bycatches of these three species warrant concern and close monitoring. In this project, we aim to develop 1) improved statistical models to quantify bycatch of marine mammals on a national level, and 2) population models to assess the population effect of this bycatch. We will design and conduct a large-scale experiment with acoustic alarms on gillnets to test whether they can help reduce bycatches of harbour porpoises. If these acoustic alarms work well, we will use a modelling and simulation-approach to determine the most efficient deployment scheme. Finally, we will examine the bycatch monitoring programme currently used in Norway, use simulations to identify potential areas of improvement, and suggest what those improvements might be. Our results will help inform the conservation of marine mammals in Norway, and the management of commercial fisheries that incur bycatch related mortality on these animals.

Sandra Núñez Egado: Infectious agents in Antarctic pinnipeds

The island of Bouvet is home to Southern elephant seals (SES, *Mirounga leonina*), Antarctic fur seals (AFS, *Arctocephalus gazelle*) and different bird species. Little is known about the stressors these animals are exposed to, such as potential pathogens causing disease in seals and possibly in humans.

Even though investigations have been done in Antarctic pinnipeds revealing its exposure to different microorganisms, information about these animals visiting Bouvet is scarce. The purpose of this study was to investigate the exposure of AFS and SES at Bouvet Island to *Toxoplasma gondii*, *Brucella pinnipedialis*, seal parapoxvirus and phocine herpes virus-1 (PhHV-1).

Blood and swab samples were collected in two austral summers (2014-2015, 2017-2018) from AFS (n= 75) and SES (n= 13). Sera were assayed for *T. gondii* and *B. pinnipedialis* antibodies. PCRs targeting for parapoxvirus *B2L* and *GIF* genomic regions and PhHV-1 glycoprotein B gene were performed. No antibodies against *B. pinnipedialis* neither *T. gondii* were detected. Sequencing of the PCR amplicons were carried out and blasted in GenBank, finding most homology with a seal parapoxvirus from a 2015 AFS pup, while no PhHV-1 amplicons were detected in any of the samples.

This is the first report showing evidence of parapoxvirus in Antarctic fur seals and in Bouvet Island.

Solveig Enoksen: Contaminants in North Atlantic marine mammals – a review

Contaminants in the form of persistent organic pollutants (POPs) in the marine food chain have been an issue for several decades. Early contaminants were PCBs and pesticides like DDT, although recently substances like brominated and chlorinated flame retardants, current-use pesticides and personal care products have become prevalent. Most POPs are lipophilic, meaning they are easily stored in fat, and since marine mammals generally have large fat reserves, they can potentially store large amounts of these contaminants. Marine mammals are also top predators, resulting in a much higher accumulation of contaminants in these species compared to species lower in the food chain. POPs can cause issues with the immune system, reproduction, hormone and vitamin levels, bone density, cognition and more, and they also pose a health risk for humans using marine mammals as a food resource. Getting an overview of the contaminant levels of different marine mammal species is therefore important from a management perspective. This presentation will show levels of select contaminants in a few marine mammal species as found through a literature review, as well as highlight issues with making such an overview.

10:15-10:30: Coffee break

10:30-11:25: Welfare/diet

Albert Palomino Gonzalez: Unmanned Aerial Vehicle (UAV) applications in polar marine predator ecology

In Polar Regions, the logistical and financial efforts required to reach land, ice or sea-based animals have limited the ability of ecologists to study them. The recent and dramatic increase in the availability of UAV technology presents a wide range of possible solutions to the issue. However, the pace at which research can assimilate these advancements is limited. From a management perspective, this leads to two major challenges: first, the scientific community needs time to explore the potential uses of UAVs in the field and compare it with traditional techniques. Additionally, to future-proof regulatory measures, understanding the disturbance potential of UAV operations on animals is deemed critical.

This project attempts to address these challenges by using three models of readily available, electrically-powered quadcopters in the High Arctic Svalbard Archipelago. Disturbance experiments involved pre-determined flight profiles of varying distances and altitudes over harbour seal and adult male walrus aggregations, performed during 2017 and 2018. Additionally, flight tests were done opportunistically over other species, such as white whales, bearded seals and polar bears. The analysis will entail scoring animal reactions and matching them to information on the position of the UAV and, as a novel approach to its acoustic signature.

Olof Bengtsson: Ringed seal (*Pusa hispida*) diet in western Spitsbergen - an ecosystem in change

Gastro-intestinal tracts (GITs) were collected from 99 ringed seals (*Pusa hispida*) in the period 2014-2017 from seven locations in Isfjorden and Van Mijenfjorden on the west coast of Spitsbergen, Svalbard. GIT contents were analyzed by identifying fish otoliths and invertebrate remains to the lowest possible taxonomic level. Polar cod (*Boreogadus saida*) was the dominant prey type, which was consumed by 86.9% of the seals (frequency of occurrence, FO_i). Polar cod was also the most numerous prey type, constituting 39% of all prey items (relative frequency, N_i). Fish from the family Stichaeidae were the second most frequent prey ($FO = 79.8\%$). The second most numerous prey type were various crustacean species in the genus *Thysanoessa* ($N_i = 40.8\%$). Using otolith length in species specific regressions, biomass of prey items will be estimated. Age, sex, location of sampling and year and month of sampling will be used to model what factors are influencing the diet of ringed seals on the west coast of Spitsbergen. Samples from this study will be compared in detail with data from the previous decade to explore temporal shifts in ringed seal diet in Svalbard. But, it is clear that Arctic species still dominate the diet of ringed seals on western Spitsbergen, though Atlantic species, e.g. Atlantic- cod and herring, haddock and boreal *Thysanoessa* species, are increasing in prevalence.

Samuel Smith: Reporting on hunting methods: a review of welfare assessment parameters in marine and terrestrial species

The hunting of marine mammals has been subject to substantial scrutiny for decades. Consideration for animal welfare outcomes has led to the development of a quantitative framework to assess hunting methods. Reporting time-to-death, the proportion of animals rendered instantaneously insensible, as well as *post-mortem* examinations, allows the humaneness of hunts to be inferred and further improved. It has been noted that the welfare of other animals during hunting is rarely assessed through combined *ante-* and *post-mortem* observations. However, recent work conducted in Australia represents considerable effort made in assessing welfare outcomes using the framework parameters developed for large cetacean hunts. Data gathered during population control operations for terrestrial mammal species have demonstrated the successful application of welfare parameter assessment. This presentation will discuss the findings of these studies, comparing the methods and results with respect to ongoing assessments of marine mammal hunts. Further, the development of welfare parameters in terrestrial mammal studies may have applications that would improve welfare in marine species.

11:25-11:30: Break

11:30-12:00: Law of the Sea

Filip Dariusz Farmas Vel Krol: Legal framework of whale protection in the Arctic

This presentation seeks to provide an overview of international regulations concerning whale protection. As a starting point, it explains relevant agreements of global range. These include the United Nations Convention of the Law of the Sea, International Convention for the Regulation of Whaling and Convention on the Conservation of Migratory Species of Wild Animals. Subsequently, presentation focuses on regional instruments of whale protection, *inter alia* the Agreement on Cooperation in Research, Conservation and Management of Marine Mammals in the North Atlantic. The last focal point is the bilateral agreement between Canada and Greenland that gave rise the Joint Commission on Beluga and Narwhal.

Presentation's purpose is to expose in a nutshell the complexity of the legal framework in relation to whale protection. It briefly describes documents, their functions and application.

Daniela Toma: Scientific Research and Whales: (mis)conceptions in International Law under the spectrum of the ICJ Whaling Case

The judgement in the International Court of Justice case Whaling in the Antarctic (Australia v. Japan: New Zealand intervening) determined that Japanese 'special permit' whaling in the Southern Ocean was not 'for the purposes of scientific research'. This is the only exemption permitted under the International Convention for the Regulation of Whaling's current moratorium on commercial whaling. The court made its determination by characterising the Japanese research program as a scientific program, but failing to define what scientific research actually was or was not. This presentation will present some background to the decision as well as will give some main points about how the court took this decision. It will conclude explaining why the court failed to take the opportunity to offer a clear determination to states on their-legal scientific obligations within international law while it will also discuss the implications of the Judgment for the International Whaling Commission, for other international treaties, and for the interaction of science and law more generally.

Anita Rayegani: Underwater Noise and the Purview of International Law

Encompassed in the global effort to attain the 2030 Sustainable Development Goals is a relatively new focus on anthropogenic underwater noise. Part XII of the United Nations Convention on the Law of the Sea (UNCLOS) reflects the customary international legal obligation for all states to protect and preserve the marine environment, and to take all measures necessary to mitigate the harmful effects of pollution. The definition of pollution itself includes *energy* introduced by humans and thus implicitly covers noise.

In addition to broad obligations, regional efforts have emerged to address more specifically the potentially harmful effects of noise introduced by human activities. In the absence of a globally binding instrument regulating underwater acoustic pollution, we can look to regional efforts, conservation principles and existing legal instruments with mandates to protect the environment to establish more elaborate regulations. An overview of current regulatory mechanisms and next steps is to be presented.

12:00-13:00: Break

13:00-14:10: Physiology

Aleksander Malde: Development of diving capacity and behaviour in harp seal (*Pagophilus groenlandicus*) weanlings from the Greenland Sea Stock

The harp seal (*Pagophilus groenlandicus*) is one of the most abundant and ecologically important seal species in the North-East Atlantic Ocean. Previous studies on the dive behaviour and distribution of the harp seal, both in the White Sea-Barents Sea stock, and in the Greenland Sea stock, have focused on adult seals. This project represents the first study to focus on the development of diving performance, behaviour and distribution of weaned harp seal pups and how they cope with the transition, in complete independence, to an aquatic/diving lifestyle, during their first months of life. Data collection was done by tagging newly weaned harp seal pups on site in the Greenland Sea, with satellite transmitters that recorded dive duration, dive depth and position. The pups appeared to rapidly (within a few weeks) develop diving capacity, such that this did not seem to represent a limitation to their subsequent diving behaviour/performance.

Judith Ullmann: The respiratory physiology of the harp seal (*Pagophilus groenlandicus*), a master's project at UiT

This presentation focuses on the first part of my master's project: determining the total lung capacity and the size of the respiratory dead space in the harp seal. Marine mammals are breath-hold divers. Anatomical and physiological adaptations of their respiratory system facilitate rapid gas exchange at the surface, long diving times, and the ability to reach great depths without suffering from barotrauma or other diving-related disorders. I excised the respiratory tracts of pups and adults in the field (West Ice, Greenland Sea) to take volumetric measurements of the lungs and of the conducting airways, from nose to bronchi. Ontogenetic differences in the proportional makeup of the respiratory tract were analyzed. To predict the lung size and dead space of individuals used for studying ventilation at rest and after exercise (second part of my project), I developed linear regression models covering the body-size range from newborn to adult. This study adds substantially to the sparse accounts of respiratory dead space in phocid seals. I will present the results of my work within the frame of general mammalian (developmental) patterns and emphasize comparisons with the human respiratory system. The difficulties of measuring total lung capacity in animals will also be touched upon.

Chiara Ciccone: Brain capillarization in diving species

Diving species can cope with acute and chronic hypoxia through adaptations that are typically less well-developed in other (non-diving) animals. One of the greatest challenges to deal with during diving is the large decrease in the arterial oxygen pressure (P_aO_2), which causes a reduced driving force for oxygen diffusion into the cells. The marine mammalian brain shows improved brain capillarization, which reduces the effective diffusion distance for O_2 , thereby improving neural oxygen supply in partial compensation for severely hypoxemic conditions.

Based on the evidences of previous studies, the aims of this project are the following:

- Investigate whether the seal brain shows higher capillarization, when compared to terrestrial mammals, as a general adaptation to hypoxia;
- Verify whether there is a different level of capillarization in different brain regions;
- Validate a method to stain the capillary endothelium and visualize the vessels.

For this purpose, the brains of 2 harp seals, 1 hooded seal and 2 reindeer were collected. Samples were taken from the frontal and visual cortex, the hippocampus, the cerebellum and the medulla.

Capillaries were identified by immunostaining of the collagen IV of their basement membrane and then visualized in the confocal microscope. Provisional results will be presented.

14:10-14:30: Coffee break

14:30-15:30: Movement/abundance

Lisa Kettner: Understanding the migratory behaviour of humpback whales in the eastern North Atlantic

In the winter of 2010, humpback whales unexpectedly started aggregating in coastal waters of northern Norway, following a shift in overwintering herring distribution. This might constitute a new stop-over site on the breeding migration of the Barents Sea feeding population. This phenomenon exemplifies our lack of understanding of humpback whale migratory regimes in the region, where the year-round distribution of these animals remains unknown. It also challenges the traditional concept of stable migratory regimes, as the observed behaviour indicates more flexible behavioural decisions. The system presents an opportunity to understand the understudied eastern Atlantic humpback whale population and the energetics of migrations in relation to ecosystem changes. In addition to photo ID (>1000) and biopsy samples (~120), we have collected Argos data from 19 individuals in coastal Norway, and additional tags were deployed on 10 individuals on the feeding grounds in the Barents Sea. We will analyse sex and pregnancy status and investigate overlap with prey distribution and abundance, as well as investigate tracks for stop-over and behavioural mode offshore and assess how whales use oceanographic and geographic features such as eddies and seamounts on their travels.

Evert Mul: Overlap between whale movement and human activities in Norwegian waters

Background: In recent years, winter herring aggregations have attracted large numbers of orcas, humpback whales and concentrated human activities (such as fisheries) to local fjord systems in Northern Norway. During these winter aggregations of herring, the potential for ship strikes, entanglements and competition between whales and human activities is relatively high. We aim to identify and characterize areas of overlap between whales and humans in order better understand the interaction between whales and humans.

Methods: We analyse satellite tracked killer whales and humpback whales in a fjord system in Norway, and we relate their spatial and temporal movement and habitat use to fishery, shipping and modelled soundscape generated from anthropogenic activities.

Expected results: We hypothesize that spatial and temporal overlap between human activity and whale movement is relatively high. In addition we expect to find an attraction between herring fisheries activity and killer whale movement and behaviour, which might be less pronounced in humpback whales. To some extent we expect to find avoidance behaviour towards ships and sound, and overlap or synchronised movements between humpback whales and killer whales, which could indicate both competition and collaboration.

Discussion: Attraction between fisheries and killer whales suggest an increase in competition, and a potential risk of entanglement and collision. Ship or sound avoidance behaviour suggests whales are actively balancing the benefits of concentrated food resources against interaction with human activities.

Deanna Leonard: Trends in abundance of large whales in Norwegian and adjacent waters based on shipboard line-transect surveys between 1995-2018

Shipboard line-transect surveys, targeting North Atlantic common minke whales (*Balaenoptera acutorostrata acutorostrata*), have been conducted in Norwegian and adjacent waters since 1995. Five complete surveys have been conducted—1995, 1996-2001, 2002-2007, 2008-2013, and 2014-2018 – with a total effort ranging from 25-30,000 km of primary transects per survey cycle, covering a total area of approximately 3,000 000 sq. km. Sightings of whales other than the target species were recorded but not analysed for abundance and distribution until now. Here, abundance estimates for large whale species (fin, humpback and sperm whales) are determined through mark-recapture distance sampling and the trends in abundance and distribution across survey periods are compared. Fin whale abundance was estimated to be 10 086 (95% CI: 6 034-16 856) with less than 5% change in abundance among survey periods. Sperm whale abundance was highest in the Norwegian Sea and ranged between 3 962 (95% CI: 2 218-7 079) and 8 053 (95% CI: 5 695-11 617). The total humpback whale estimated abundance has increased substantially from the first survey period from 1 058 (95% CI: 645-1 738) in 1995 to 9 335 (95% CI: 6 607-19 082) in the 2008-2013 survey period. The increase in abundance occurred most prominently in the Barents Sea and Svalbard survey regions. Spatial models were used to predict sightings as functions of environmental and geospatial covariates and map the predicted densities of humpback, minke, and fin whales to identify spatial trends and factors that affect abundance.

15:30-18:00: Activity for student presenters

18:00-21:00: Evening event

18:00-18:15: Introduction

18:15-19:00: **Richard Caddell:** NAMMCO and International Law: What Makes an Organisation "Appropriate" for the Conservation and Management of Marine Mammals?

Dr Richard Caddell is a Lecturer in Law at Cardiff University, from which he also gained his PhD, examining the international regulation of cetaceans. Richard's primary research interests lie in the law of the sea and international environmental law, particularly marine mammal issues, fisheries governance, marine conservation and Polar law. He is the co-editor of *Strengthening International Fisheries Law in an Era of Changing Oceans* (Hart, 2019) and *Shipping, Law and the Marine Environment in the Twentieth Century* (Lawtext, 2013), and has published numerous legal articles on marine mammals, migratory species and Arctic regulation. He regularly advises national governments, inter-governmental bodies and NGOs on environmental and marine issues and is an academic member of Francis Taylor Building, the UK's foremost Environment Law set of barristers.

19:15-20:00: **Anniken Førde:** Responsible whale watching?

Anniken Førde is an associate professor in Planning and Culture at the Department of Social Sciences, UiT. Her research focus on transformation of coastal communities and landscapes, and she has for many years worked on responsible tourism development. In the ongoing research project Whalefeast; Ecological, commercial and social challenges of the recent extreme winter arrivals of whales in Northern Norway, she is part of a team looking at strategies for securing responsible whale watching practices.

20:15-21:00: **Christian Lydersen:** Ongoing research on walrus, beluga and bowhead whales

Christian Lydersen is a senior research scientist working with marine mammals at the Norwegian Polar Institute in Tromsø. His main areas of interest and expertise include marine mammalogy and physiology, population biology and ecology.

Coffee/tea and snacks will be provided during the coffee breaks and for the evening event.

Please bring your own mugs, as we will not provide single-use cups.

The Symposium is held in Blix-salen in the Arctic Biology building at UiT campus.